

## **AUTOMATIC TRANSMISSION APPARATUS FOR VEHICLE**

### **CROSS REFERENCE TO RELATED APPLICATIONS**

This application is based upon and claims the benefit  
5 of priority from the prior Japanese Patent Applications No.  
P2003-026110, filed on February 3, 2003; the entire contents  
of which are incorporated herein by reference.

### **BACKGROUND OF THE INVENTION**

#### **10 1. Field of the Invention**

The present invention relates to an automatic  
transmission apparatus for a vehicle, which reduces a load  
for changing a range position of the automatic transmission  
by adding an assisting force to an operating being input to a  
15 select lever whereby reduces a load of a passenger.

#### **2. Description of the Related Art**

Heretofore, there is a technique of reducing an  
operating force for changing a range position of an automatic  
20 transmission in a motor vehicle or the like for assisting an  
operating force by a passenger (for example, refer to a  
related invention 1: Japanese Patent Application Laid-Open No.  
11-286225).

A manual changing servo assisting apparatus described  
25 in the related invention 1 is provided with a shift lever

arranged in a steering column of the motor vehicle, a servo actuator for reducing a shift operating force for changing a gear position of an automatic transmission by adding an assisting force to the operating force, and a Bowden cable  
5 connecting the shift lever to the servo actuator.

However, in the technique described in the related invention 1, since the Bowden cable connecting the shift lever locating inside a passenger room to the servo actuator locating outside the passenger room is very long, there is a  
10 risk that a play is generated in the cable. Owing to this play, there is a risk that a stroke of the shift lever generates an overs and shorts compared with a specified stroke for changing a position of the automatic transmission. For example, in the case that the play of the Bowden cable is  
15 very large, there is a case that the position of the automatic transmission is not changed even at a time when the passenger controls the shift lever so as to change the position.

Accordingly, an object of the present invention is to  
20 provide an automatic transmission apparatus for a vehicle which can securely change a gear to each of positions of an automatic transmission, even in the case that a play is generated in a Bowden cable for transmitting an operating force being input to a shift lever constituting a control

inputting apparatus to a power assisting apparatus.

### SUMMARY OF THE INVENTION

An automatic transmission apparatus according to the  
5 present invention has been made in order to solve the above-  
described problems, and the apparatus comprising: a control  
inputting apparatus having a select lever for changing a  
range position of an automatic transmission; a power  
assisting apparatus adding an assisting force to a control  
10 force input to the control inputting apparatus so as to  
output to the automatic transmission; a first transmitting  
means for transmitting the control force from the control  
inputting apparatus to the power assisting apparatus; and a  
second transmitting means for transmitting an output force  
15 from the power assisting apparatus to the automatic  
transmission, wherein the control inputting apparatus is  
provided in a vehicle body member near a steering wheel, and  
the power assisting apparatus is provided in a vehicle body  
member close to the passenger's foot, whereby the control  
20 inputting apparatus and the power assisting apparatus are  
arranged apart from each other.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross sectional view showing a schematic structure of an automatic transmission apparatus for a vehicle according to the present embodiment;

5 Fig. 2 is a view showing a power assisting apparatus according to the present invention;

Fig. 3 is a cross sectional view along a line III-III in Fig. 2;

Fig. 4 is a schematic view showing a position detecting means according to an embodiment of the present invention;  
10 and

Fig. 5 is an explanatory view of a motion of the automatic transmission apparatus according to the embodiment of the present invention.

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#### DETAILED DESCRIPTION OF THE INVENTION

An embodiment of the present invention will hereafter be explained with reference to Figs. 1 to 5.

An automatic transmission apparatus for a vehicle  
20 according to the present embodiment is comprised of a control inputting apparatus 2 for changing a range position of an automatic transmission 1 (a transmission), a power assisting apparatus 3 adding an assisting force to an operating force being input to the control inputting apparatus 2 so as to  
25 output to the automatic transmission 1, a first cable 4

functioning as a first transmitting means for transmitting the operating force to the power assisting apparatus 3, a second cable 5 functioning as a second transmitting means for transmitting a force obtained by adding the assisting force to the operating force to the automatic transmission 1, an operating force detecting means for detecting the operating force, a position detecting means for detecting a rotational position of an output shaft outputting the assisting force in addition to the operating force to the automatic transmission 1, and a controller for stopping the output shaft at a stop position of the output shaft in correspondence to each of preset range positions of the automatic transmission 1, as shown in Fig. 1.

With reference to Fig.1, the automatic transmission 1 controls the control inputting apparatus 2 mentioned below and actuates a manual valve (not shown) within a control valve unit (not shown) so as to change a hydraulic pressure with respect to a selected range position. The automatic transmission 1 is arranged within an engine room 6.

With reference to Fig. 1, the control inputting apparatus 2 comprises a select lever 7 and a lever box 8 supporting the select lever 7, and is configured to change a range position, such as a P range (Parking), an R range (Reverse), an N range (Neutral), a D range (Drive), an L range (Low) of the automatic transmission 1 by controlling

the select lever 7.

The select lever 7 comprises a lever knob 7a and the lever knob 7a is arranged within a passenger room 10 in which a steering wheel 9 and the like are provided. A driver, for example, slides the select lever 7 in a longitudinal direction, whereby each of the range positions of the automatic transmission 1 is determined. The lever box 8 is provided within an instrument panel chamber 14 which is defined by an instrument panel 11, a dash panel 12 and a floor panel 13. The passenger room 10 and the engine room 6 are defined by the instrument panel 11, the dash panel 12 and the floor panel 13.

With reference to Fig.3, the first cable 4 transmits the operating force generated at a time when the driver operates the select lever 7 to the power assisting apparatus 3. The first cable 4 is structured such that one end is fixed to a lever side arm 15 provided in the lever box 8 and another end is fixed to an input side arm 16 provided in the power assisting apparatus 3, thereby transmitting the operating force generated by controlling the select lever 7 to the power assisting apparatus 3. Most part of the first cable 4 is arranged within the instrument panel chamber 14.

As shown in Fig. 1, one end of the second cable 5 is fixed to an output side arm 17 of the power assisting apparatus 3, and another end of the second cable 5 is fixed

to a control arm (not shown) of the manual valve of the automatic transmission 1, thereby transmitting the output obtained by adding the assisting force to the operating force to the automatic transmission 1.

5           As shown in Fig. 1, the power assisting apparatus 3 is fixed to the floor panel 13 being located in the vicinity of the foot of the passenger. The power assisting apparatus 3 corresponds to an apparatus for controlling the select lever 7 and adding the assisting force to the operating force  
10 generated in the control inputting apparatus 2 so as to output to the automatic transmission 1.

          As shown in Figs. 2 and 3, the power assisting apparatus 3 has an assisting force generating portion 18 for generating the assisting force, an input shaft 19 for  
15 inputting the operating force transmitted by the first cable 4, and an output shaft 20 for outputting the force obtained by adding the assisting force to the operating force.

          The assisting force generating portion 18 is comprised of an electric motor 21, a worm gear 23 fixed to a drive  
20 shaft 25 of the electric motor 21 received within a case housing 22 formed by an aluminum die casting or the like, and a worm wheel gear 24 functioning as an output gear engaging with the worm gear 23.

          The drive shaft 25 of the electric motor 21 protrudes  
25 into the case housing 22 from a side surface of the electric

motor 21. Further, a main body portion 21a of the electric motor 21 is fixed to an outer side of the case housing 22. The worm gear 23 is supported to a bearing 26 provided within the case housing 22, and rotates together with the drive  
 5 shaft 25 of the electric motor 21. The worm wheel gear 24 is formed in a fan shape, and engages with the worm gear 23 so as to reduce a rotational speed of the electric motor 21. The worm gear 24 is configured to swing within a predetermined angle range.

10 The input shaft 19 and the output shaft 20 are formed as input and output shafts having a coaxial structure, and an axial center portion 27 thereof is rotatably supported by a bearing 28 provided within the case housing 22. The input shaft 19 is provided within the case housing 22, however, the  
 15 output shaft 20 is provided so as to protrude to an outer side of the case housing 22. The worm gear 24 mentioned above is pressed into the axial center portion 27 of the input shaft 19 and the output shaft 20 having the coaxial structure. Accordingly, when the worm wheel gear 24 rotates, the output  
 20 shaft 20 also rotates.

A torque sensor 29 corresponding to the operating force detecting means detects the operating force transmitted by the first cable 4 as a rotational torque. The torque sensor 29 has a rotation shaft 31 fixed to the input side arm 16 by  
 25 a screw 30, as shown in Fig. 3, and outputs a rotational



torque of the rotation shaft 31 as a control torque signal. Further, the rotation shaft 31 is pressed into the input shaft 19 and the output shaft 20 formed as the input and output integral shaft so as to be integrally formed.

5 With reference to Figs. 2 to 4, the position detecting means is comprised of a detector 32 for detecting a rotational position of the output shaft 20, and a resistance substrate 33 for slidably contacting a contact point 32a of the detector 32.

10 The detector 32 is constituted by a conductive metal plate having a contact point 32a in a leading end portion, and has a mounting portion 34 which is integrally formed by an insulative material in a base end portion. The detector 32 is mounted by fixing the mounting portion 34 to one main  
15 surface of the worm wheel gear 24. The detector 32 is structured such that the contact point 32a in the leading end thereof is folded in a direction of moving apart from the worm wheel gear 24, and is not brought into contact with the worm wheel gear 24. Further, the detector 32 is fixed to the  
20 worm wheel gear 24 via the mounting portion 34 formed by the insulative material so as to be prevented from being conductive with the worm wheel gear 24, whereby an insulating property is secured.

The resistance substrate 33 is formed as a circular arc  
25 conductor layer in correspondence to a moving locus of the

contact point 32a of the detector 32 fixed to the worm wheel gear 24, and is provided in an inner surface of the case housing 22 opposing to the detector 32. The structure is made such that the contact point 32a of the detector 32 is  
5 slidably contacted with the resistance substrate 33, whereby a resistance value detected by the detector 32 changes, and the rotational position of the output shaft 20 rotating integrally with the worm wheel gear 24 can be detected based on the change of resistance value.

10 The controller 37 functioning as the control means executes a control of stopping the output shaft 20 at the stopping position of the output shaft 20 in correspondence to each of the preset range positions of the automatic transmission 1. As shown in Fig. 1, the control torque  
15 signal from the torque sensor 29 and a range signal from an inhibitor switch 35 are input to an assist controller 36, and an assisting force is computed by the assist controller 36. A signal including information such as the computed assisting force and the like is input to the controller 37 by the  
20 assist controller 36.

The inhibitor switch 35 is provided in the automatic transmission 1, detects a selected range position and outputs a range position signal. The assist controller 36 starts operation based on generation of an ignition power source,  
25 inputs the control torque signal from the torque sensor 29

and the range position signal from the inhibitor switch 35, computes a target assisting force based on the input information, and outputs a command for obtaining the target assisting force to the electric motor 21.

5           The controller 37 corresponding to the control means previously sets a stop position of the output shaft 20 on the assumption that the automatic transmission 1 is at a position where the automatic transmission 1 is securely changed to each of the range position, with taking into consideration a  
10   play of the stroke between the first cable 4 and the second cable 5, and controls the electric motor 21 such that the output shaft 20 stops at the preset stop position in the case that the output shaft 20 does not rotate to a proper position due to a lack of stroke, or in the case that the output shaft  
15   20 rotates so as to pass through the proper position.

As shown in Fig. 5, in the case that when moving the select lever 7 from a P position to an R position, the detector 32 and the resistance substrate 33 corresponding to the position detecting means detect that the output shaft 20  
20   stops short of a preset stop position (a position shown by a line A in Fig. 5) due to the play caused by the deflection of the first cable 4 or the like, a stroke (a range shown by an arrow B in Fig. 5) moved by the control inputting apparatus 2 comes short of the required stroke for the properly changed  
25   position. Accordingly, the controller 37 controls the

driving of the electric motor 21 so as to rotate the output shaft 20 to the preset stop position. Accordingly, the output shaft 20 is rotated at an amount of a corrected value (a range shown by an arrow C in Fig. 5) calculated by the position detection. According to the motions mentioned above, it is possible to securely stop at the position where the position of the automatic transmission 1 is changed.

In the automatic transmission apparatus for the vehicle according to the present embodiment having the structure mentioned above, since the control inputting apparatus 2 is provided in the instrument panel 11 and the power assisting apparatus 3 is provided in the floor panel 13, it is possible to reduce a noise generated at a time of driving the power assisting apparatus 3, and it is possible to improve a freedom of doing the layout of the inner portion of the passenger room 10.

In the case of integrally forming the control inputting apparatus and the power assisting apparatus, the electric motor is formed in a protruding shape by arranging these apparatuses within the instrument panel chamber. Accordingly, since the freedom of doing the layout is reduced, and the electric motor is arranged near ears of the passenger, an operation sound falls on the passenger's ears. However, in the case that the control inputting apparatus 2 and the power assisting apparatus 3 are arranged separately and the power

assisting apparatus 3 generating a loud operation sound is particularly arranged on the floor panel 13 close to the passenger's feet, as in the present embodiment, it is possible to further reduce the noise.

5           Further, in the automatic transmission apparatus for the vehicle according to the present embodiment, since the rotation shaft 31 of the torque sensor 29 is integrally structured on the same axis of the output shaft 20 of the power assisting apparatus 3, no play is generated between the  
10   output shaft 20 and the rotation shaft 31 of the torque sensor 29. Accordingly, it is possible to detect accurately. Further, since the torque sensor 29 outputs a detection value by an extremely low power electric current, a noise is added to the detection value, the motor power does not carry out an  
15   accurate operation and the operating force is large, in the case that the control inputting apparatus 2 has the torque sensor 29 built-in. However, in the present embodiment, since the case housing 22 is formed by the aluminum die casting, the case housing 22 is hard to be exposed to a radio  
20   faulty such as a radio noise or the like and it is possible to prevent a malfunction.

          Before describing the operation of the automatic transmission apparatus for the vehicle mentioned above, a description will be briefly given of a reason why the  
25   position of the automatic transmission 1 is not changed due

to the generation of the play in the first cable 4 and the second cable 5.

When arranging the power assisting apparatus 3 on the floor panel 13, a play (hereinafter, refer to a play 1) in stroke is generated in the first cable 4 provided between the control inputting apparatus 2 and the power assisting apparatus 3, due to a long entire length. In the same manner, a play (hereinafter, refer to a play 2) is generated between the power assisting apparatus 3 and the automatic transmission 1. Further, since a locus is different between the first cable 4 and the second cable 5, a generating way of the play is different.

In the case that the control inputting apparatus 2 has the torque sensor 29 corresponding to the means for detecting the operating force built-in, the torque sensor 29 detects a torque 0 so as to stop the power, at a time when the stroke of the select lever 7 is completed. In the operation at the position where the play 2 is larger than the play 1, a lack of stroke is generated, and the position of the automatic transmission 1 is not changed.

Next, a description will be given of an operation of the automatic transmission for the vehicle according to the present embodiment. In the present embodiment, when sliding the select lever 7 from the position P to the position R, the operating force generated in the control inputting apparatus

2 is detected by the torque sensor 29 via the first cable 4. The detected torque signal is transferred to the assist controller 36. The assist controller 36 computes the assisting force based on the torque signal and the range  
5 position signal transmitted from the inhibitor switch 35, and commands the controller 37 such that the torque obtained by adding the assisting force to the operating force is output to the electric motor 21.

The controller 37 rotates the drive shaft 25 based on  
10 the command. Accordingly, the worm gear 23 fixed to the drive shaft 25 rotates, and turns the worm wheel gear 24 engaged with the worm gear 23. When the worm wheel gear 24 rotates, the output shaft 20 fixed to the rotation axis of the worm wheel gear 24 rotates. The contact point 32a of the  
15 detector 32 fixed to the worm wheel gear 24 is brought into slidable contact with the resistance substrate 33 provided in the inner surface of the case housing 22, whereby a rotational position of the output shaft 20 is always detected by a position detecting means for detecting the rotational  
20 position of the output shaft 20.

In this case, even when some overs and shorts is generated in the stroke due to the play 1 of the first cable 4, the controller 37 actuates the electric motor 21 until the output shaft 20 reaches the position corresponding to the  
25 preset stop position even in the case that the detected

operation torque is 0, thereby rotating the output shaft 20.  
In this case, the controller 37 actuates the electric motor  
21 such that the output shaft 20 rotates up to the preset  
stop position including both of the case that the output  
5 shaft 20 does not rotate up to the preset stop position and  
the case that the output shaft 20 runs over the stop position.  
At this time, since the rotational position of the output  
shaft 20 is always detected by the position detecting means,  
the output shaft 20 securely stops at the stop position  
10 mentioned above. As mentioned above, even in the case that  
the first cable 4 has the play 1, the position of the  
automatic transmission 1 is securely changed to the position  
R.

In this case, the present invention is not limited to  
15 the embodiment mentioned above, and can be modified and  
changed variously within the scope of the present invention.